Preventative effect of massage on gastric volvulus in infants with gastroesophageal reflux-induced pneumonia

Yan Suqi, Xiong Xiaoli, Wan Qi, Liu Fan, Tang Jianqiao, Jiang Zhixia, Zhou Lishan, Yuan Kai, Xie Dong

Abstract

OBJECTIVE: To study the preventative effects of massage on gastric volvulus (GV) in infants with gastroesophageal reflux (GER)-induced pneumonia.

METHODS: One-hundred and eighty GV with GER-induced pneumonia inpatients were divided randomly into four groups: basic treatment 1 (n = 60), basic treatment 2 (n = 30), massage treatment 1 (n = 60) and massage treatment 2 (n = 30). Clinical examinations selected between groups 1 and 2 were different. Radiography of the upper gastrointestinal tract using iodine-containing contrast was assessed in group 1 before and after treatment, whereas 24-h pH monitoring of the distal esophagus was assessed in group 2 before and after treatment. Symptom scores and chest radiography were assessed in all groups upon hospital admission and after procedures. Clinical effects were estimated after procedures in all groups. The prevalence of severe pneumonia among the four groups was compared.

RESULTS: Massage treatment groups showed a significantly higher percentage of cure and total effect (P < 0.05, P < 0.01) and a lower prevalence of recurrence (but with no statistic difference, P > 0.05) than basic treatment groups. Furthermore, massage treatment groups had remarkably lower scores for symptoms and signs (P < 0.05, P < 0.01), especially for choking on milk, than basic treatment groups. There was significant attenuation of chest inflammation (P < 0.05, P < 0.01), GV (P < 0.05, P < 0.01) and GER (P < 0.05, P < 0.01) in massage treatment groups compared with those in basic treatment groups. Finally, massage treatment groups demonstrated a lower prevalence of severe pneumonia than basic treatment groups (P < 0.05).

CONCLUSION: Massage treatment can prevent GV with GER-induced pneumonia in infants by timely correction of stomach rotation and subsequent attenuation of GER.

INTRODUCTION

Pneumonia with severe coughing and recurrent respiratory infections that is refractory to antibiotic treatment
in those aged < 6 months warrants targeted therapy. Our previous retrospective study based on 792 hospitalized infants (1-4 months) with pneumonia admitted to Wuhan Children’s Hospital (Hubei, China) demonstrated a prevalence of 80.72% of gastric volvulus (GV) in patients failing to respond to antibiotic treatment and a prevalence 67.22% of gastroesophageal reflux (GER) in those GV patients. We found that infant pneumonia was closely related to GV with GER, and that the complications of GER may be responsible for the ineffectiveness of antibiotic treatment in infant pneumonia. Therefore, therapies designed to improve GER are crucial for the treatment of GV in GER-induced pneumonia in infants.

In the present study, we recruited 180 infants (1-6 months) admitted to the Department of Integrated Traditional Chinese and Western Medicine of Wuhan Children’s Hospital for GV with GER-induced infant pneumonia. Massage was carried out for GV for the treatment of pneumonia.

METHODS

The present study was conducted in the Department of Integrated Traditional Chinese and Western Medicine at Wuhan Children’s Hospital from March 2010 to March 2013. Parents gave written informed consent for their infants to participate in the study. The study protocol was approved by the Ethics Committee of the Wuhan Medical Care Center for Women and Children.

Diagnostic criteria
Diagnosis criteria for infant pneumonia (including bronchiolitis) were applied according to those described in Zhu Futang Practical Pediatrics for ages 1 month to 6 months.

For GV, radiography of the upper gastrointestinal tract (UGT) using iodine-containing contrast had to reveal gastric rotation (organoaxial, mesenteroaxial, combined volvulus (stomach rotation of < 180°), reversible volvulus) without obstruction of the gastrointestinal tract (paraeosophageal hernia, congenital hypertrophic pyloric stenosis).

For GER, 24-h pH monitoring of the distal esophagus was undertaken using a HYW Upper Gastrointestinal pH Dynamic Tester (Beijing Changan Henderson Electronics, Beijing, China). Four parameters were recorded: (a) percentage of time pH ≤ 4 over 24-h; (b) percentage of time pH ≤ 4 over 24 h while infant was lying down; (c) percentage of time pH ≤ 4 over 24 h while infant was standing erect; (d) prevalence of pH ≤ 4; (e) prevalence of pH ≤ 4 lasting > 5 min and the maximum duration of reflux.

GRE was defined as: a frequency of pH ≤ 4 of > 50; a frequency of pH ≤ 4 lasting > 5 min of > 3; the maximum duration of reflux > 10 min. GER was also demonstrated by the DeMeester Score. A DeMeester score of < 14.72 was "normal", 14.72-50 was "mild acid reflux", 50-100 was "moderate acid reflux", and > 100 was "severe acid reflux". GER was also estimated by radiography of the UGT using iodine-containing contrast. "Iodine reflux" was defined as more than three-fold within 5 min and the angle of His became obtuse (30°-50° is normal).

Inclusion criteria
Inclusion criteria were all patients diagnosed with infant pneumonia (including bronchiolitis), GV and GER, without kidney or hematologic diseases, and aged 1-6 months.

Exclusion criteria
Exclusion criteria were patients: transferred to the Intensive Care Unit for type-II respiratory failure necessitating a tracheal cannula and mechanical ventilation; who had discontinued treatment; and who had incomplete data.

Study population
One-hundred and eighty eligible patients aged 1-6 months (2.03 ± 1.11 month) were divided into four groups using a random number table: basic treatment 1 (n = 60), basic treatment 2 (n = 30), massage treatment 1 (n = 60) and massage treatment 2 (n = 30). Clinical examinations selected between groups 1 and 2 were different. Radiography of the UGT using iodine-containing contrast was assessed in group 1, whereas 24-h pH monitoring of the distal esophagus was assessed in group 2. Baseline clinical and symptomatic characteristics are listed in Table 1. There were no significant differences between the four groups (P > 0.05).

Interventions
Basic treatment: for pneumonia, basic treatment was according to the Convention on the Diagnosis and Treatment of Infant Pneumonia and Bronchiolitis.

For GV and GER, there were three types of therapy. The first type of therapy was postural. The infant was kept in the reverse Trendelenburg position in the arms during feeding. After feeding and without variation in the amplitude of the position and percussion on the back within 1 h, the upper body was elevated 30°, maintained on his/her right side for 60 min, and placed on a bed (tuned to a 30°-40° slope). The orthostatic or > 45° prone position should be maintained when holding a baby. The second type of treatment was dietary. It was based on thickening of meals and macologic: proton pump inhibitor (omeprazole: 0.5-0.8 mg/kg, qd, 30 min before breakfast, continued for 2 weeks) and prokinetic (domperidone: 0.2-0.3 mg/kg, tid, 30 min before a meal, continued for 2 weeks).
**Massage treatment**

Based on basic treatment without omeprazole, massage (once a day; 15 ± 2 min each time, continued for 1 week) was added. According to Pediatric Tuinaology, 6 acupoint selection and massage were undertaken in four steps: (a) push from the palmar crease to Banmen (rectilinear pushing manipulation) 300 times to a depth of 0.2-0.3 cm; (b) push vicissitudinally abdominal Yin and Yang (finger-pushing massage) 200 times (organoaxial: from Tanzhong (RN 17) to hypochondrium; mesenteroaxial: from Zhongwan (CV 12) to umbilicus) to a depth of 0.5 cm; (c) palpate the abdomen (clockwise) 100 times to a depth of 0.5 cm; (d) poke alternately bilateral Zusanli (ST 36) 100 times to a depth of 0.2-0.3 cm.

**Outcome measurement**

Symptoms, physical signs and laboratory studies: first, the score of cough, dyspnea, vomiting of milk, and choking on milk before and after treatment was taken. Second, the prevalence of clinical cure and prevalence of total effective cure was noted. Third, chest radiography after treatment was recorded. Fourth, radiography of the UGT using iodine-containing contrast was used and massage treatment was not administrated; Fifth, 24-h pH monitoring of the distal esophagus was assessed and massage treatment was not administrated; Sixth, the morbidity of severe pneumonia in both basic treatment groups and massage treatment groups before and after treatment was recorded. Finally, the prevalence of recurrence in patients discharged from hospital within 1 week was recorded.

Scoring methods for symptoms and physical signs: the scoring method for symptoms and physical signs was applied according to the Guidelines of 'Traditional Chinese Medicine New Drug Clinical Research' and the scoring method for major symptoms. 6 Four classifications were made according to the severity of symptoms and physical signs.

- **Dyspnea**: asymptomatic score was "0"; score was "1" if respiratory rate > 50-60/min; score was "2" if respiratory rate > 60-70/min; score was "3" if respiratory rate > 70/min.
- **Coughing**: score was "0" if < 20 times/24 h and ≤ 3 whoops/time; score was "1" if > 20 times/24 h accompanied with a choking cough > 3 times; score was "2" if > 20 times/24 h accompanied with a choking cough > 3-5 times; score was "3" if > 20 times/24 h accompanied with a choking cough > 5 times.
- **Vomiting of milk**: asymptomatic score was "0"; score was "1" if 1-3 times/24 h; score was "2" if > 3-5 times/24 h; score was "3" if > 5 times/24 h.
- **Choking on milk**: asymptomatic score was "0"; score was "1" if once/24 h; score was "2" if twice/24 h; score was "3" if more than twice/24 h.
- **DeMeester score**: score was "0" if ≤ 14.72; score was "1" if > 14.72-50; score was "2" if > 50-100; score was "3" if > 100.

**Criteria for evaluation of effects**

- **Cure**: defined as: a reduction in symptom score > 70%; chest radiography showed disappearance/absorption of inflammatory foci; radiography of the UGT using iodine-containing contrast showed gastric reset without GER or reduction of the DeMeester score ≥ 66%.
- **Significant effect**: defined as: reduction in symptom score 50%-70%; chest radiography showed partial absorption of inflammatory foci; radiography of the UGT using iodine-containing contrast showed attenuation of a reversible volvulus without GER or reduction of the DeMeester score ≥ 33%-66%.
- **Effect**: defined as a reduction in symptom score 30%-50%; chest radiography showed slight attenuation or non-aggravation of inflammatory foci; radiography of the upper gastrointestinal tract using iodine-containing contrast showed gastric reset without GER or reduction of the DeMeester score ≥ 13%-33%.
- **Non-effect**: defined as: no reduction in symptom score; chest radiography showed aggravation of the inflammatory foci and not reduced against reflux.

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**Table 1 Baseline clinical and symptomatic characteristics of study patients (x ± s)**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>BTG1 (n = 60)</th>
<th>MTG1 (n = 60)</th>
<th>BTG2 (n = 30)</th>
<th>MTG2 (n = 30)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (months)</td>
<td>2.0±1.0</td>
<td>2.1±1.1</td>
<td>2.0±1.1</td>
<td>2.0±1.0</td>
</tr>
<tr>
<td>Male/female (n)</td>
<td>39/21</td>
<td>38/22</td>
<td>20/10</td>
<td>21/9</td>
</tr>
<tr>
<td>Cough (n)</td>
<td>60</td>
<td>60</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Dyspnea (n)</td>
<td>41</td>
<td>40</td>
<td>22</td>
<td>21</td>
</tr>
<tr>
<td>Vomiting of milk (n)</td>
<td>57</td>
<td>55</td>
<td>29</td>
<td>28</td>
</tr>
<tr>
<td>Choking on milk (n)</td>
<td>37</td>
<td>36</td>
<td>17</td>
<td>18</td>
</tr>
<tr>
<td>Severe pneumonia (n)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type- I respiratory failure</td>
<td>16</td>
<td>14</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Type- II respiratory failure</td>
<td>6</td>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Others</td>
<td>18</td>
<td>19</td>
<td>7</td>
<td>6</td>
</tr>
</tbody>
</table>

Notes: BTG1: basic treatment group 1 (radiography of the upper gastrointestinal tract using iodine-containing contrast was assessed and massage treatment was not administrate); MTG1: massage treatment group 1 (radiography of the upper gastrointestinal tract using iodine-containing contrast was assessed and massage treatment was administrate); BTG2: basic treatment group 2 (24-h pH monitoring of the distal esophagus was assessed and massage treatment was not administrate); MTG2: massage treatment group 2 (24-h pH monitoring of the distal esophagus was assessed and massage treatment was administrate); "Others" include cardiac failure and electrolyte disturbances.
phy of the UGT using iodine-containing contrast showed attenuation of a reversible volvulus (narrowing of the angle of His) but with GER or reduction of the DeMeester score < 33%.

"Ineffective" was defined as a reduction in symptom score < 30%; chest radiography showed aggravation of inflammatory foci; no significant difference in follow-up of radiography of the UGT using iodine-containing contrast or the DeMeester score.

In all cases, reduction of symptom score was attained using the following equation:
Reduction in symptom score = (score before treatment - score after treatment) / score before treatment × 100%.

Safety observations
Safety observations were based on: (a) general physical examination; (b) routine measurements of blood and urine, stool tests, and electrocardiography; (c) renal function test and prothrombin time/activated partial thromboplastin time; (d) feeling uncomfortable after massage.

Statistical analyses
SPSS v13.0 (IBM, Armonk, NY, USA) was used for data analyses. Data are the mean ± standard deviation ( x ± s ). Comparison between groups was by the Student's t-test. Count data were analyzed using the χ² test. Grade data were evaluated using the Ridit analysis. P < 0.05 was considered statistically significant.

RESULTS

Clinical effects
After treatment, massage treatment groups showed a prevalence of cure of 72.22% and prevalence of total effect (including cure, significant effect and effect) of 97.75%, whereas basic treatment groups showed values of 54.22% and 79.52%, respectively. Compared with basic treatment groups, massage treatment groups showed significantly higher percentages for cure and total effect (P < 0.05, P < 0.01), and a lower prevalence of recurrence (but with no statistic difference, P > 0.05) (Table 2).

Symptoms
After treatment, all groups had significantly reversed symptoms (coughing, dyspnea, vomiting of milk, choking on milk; P < 0.01). In contrast to basic treatment groups, massage treatment groups had remarkably lower scores for symptoms and signs (P < 0.05, P < 0.01), especially for choking on milk (Table 3).

Table 2 Curative effect after procedures in patients [n (%)]

<table>
<thead>
<tr>
<th>Symptom</th>
<th>MTG1 (n = 59)</th>
<th>MTG2 (n = 29)</th>
<th>MTG (n = 88)</th>
<th>BTG1 (n = 56)</th>
<th>BTG2 (n = 27)</th>
<th>BTG (n = 83)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cure</td>
<td>43 (72.88)</td>
<td>22 (75.86)</td>
<td>65 (73.86)</td>
<td>29 (51.78)</td>
<td>13 (48.15)</td>
<td>45 (54.22)</td>
</tr>
<tr>
<td>Significant effect</td>
<td>11 (18.64)</td>
<td>6 (20.69)</td>
<td>17 (19.32)</td>
<td>11 (19.64)</td>
<td>6 (22.22)</td>
<td>14 (16.87)</td>
</tr>
<tr>
<td>Effect</td>
<td>4 (6.78)</td>
<td>1 (3.45)</td>
<td>5 (5.68)</td>
<td>4 (7.14)</td>
<td>2 (7.41)</td>
<td>6 (7.23)</td>
</tr>
<tr>
<td>Non-effective</td>
<td>1 (1.70)</td>
<td>0 (0.00)</td>
<td>1 (1.14)</td>
<td>11 (19.64)</td>
<td>6 (22.22)</td>
<td>17 (20.48)</td>
</tr>
<tr>
<td>Total effect</td>
<td>58 (98.30)</td>
<td>29 (100.00)</td>
<td>87 (98.86)</td>
<td>45 (80.36)</td>
<td>21 (77.78)</td>
<td>66 (79.52)</td>
</tr>
<tr>
<td>Recurrence</td>
<td>1 (1.70)</td>
<td>0 (0.00)</td>
<td>1 (1.14)</td>
<td>8 (14.29)</td>
<td>4 (14.81)</td>
<td>12 (14.46)</td>
</tr>
</tbody>
</table>

Notes: BTG1: basic treatment group 1 (omeprazole: 0.5-0.8 mg/kg, qd, 30 min before breakfast, continued for 2 weeks; domperidone: 0.2-0.3 mg/kg, qd, 30 min before a meal, continued for 2 weeks); BTG2: basic treatment group 2 (omeprazole: 0.5-0.8 mg/kg, qd, 30 min before breakfast, continued for 2 weeks; domperidone: 0.2-0.3 mg/kg, qd, 30 min before a meal, continued for 2 weeks); BTG: Basic treatment groups 1 and 2; MTG1: massage treatment group 1 (domperidone: 0.2-0.3 mg/kg, tid, 30 min before a meal, continued for 2 weeks; massage: (15 ± 2) min each time, qd, continued for 1 week); MTG2: massage treatment group 2 (domperidone: 0.2-0.3 mg/kg, tid, 30 min before a meal, continued for 2 weeks; massage: (15 ± 2) min each time, qd, continued for 1 week); MTG: massage treatment groups 1 and 2. "Total effect" includes cure, significant effect and effect. P < 0.05, P < 0.01 vs BTG1; P < 0.05 vs BTG2; P < 0.01 vs BTG.

Table 3 Symptoms at baseline and after procedures in patients (scores, x ± s )

<table>
<thead>
<tr>
<th>Symptom</th>
<th>MTG1 (n = 59)</th>
<th>BTG1 (n = 56)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before</td>
<td>After</td>
</tr>
<tr>
<td>Cough</td>
<td>1.9±0.8</td>
<td>0.7±0.6&quot;</td>
</tr>
<tr>
<td>Vomiting of milk</td>
<td>2.0±0.7</td>
<td>0.7±0.6&quot;</td>
</tr>
<tr>
<td>Choking on milk</td>
<td>1.9±0.7</td>
<td>0.7±0.6&quot;</td>
</tr>
<tr>
<td>Dyspnea</td>
<td>2.0±0.8</td>
<td>0.6±0.6&quot;</td>
</tr>
</tbody>
</table>

Notes: BTG1: basic treatment group 1 (omeprazole: 0.5-0.8 mg/kg, qd, 30 min before breakfast, continued for 2 weeks; domperidone: 0.2-0.3 mg/kg, tid, 30 min before a meal, continued for 2 weeks); MTG1: massage treatment group 1 (domperidone: 0.2-0.3 mg/kg, tid, 30 min before a meal, continued for 2 weeks; massage: (15 ± 2) min each time, qd, continued for 1 week). P < 0.05 , P < 0.01 vs BTG1-after; P < 0.05 vs before.

Clinical examinations
After treatment, all groups showed reversal of chest inflammation as demonstrated by chest radiography. Compared with the basic treatment group, the massage treatment groups showed significant attenuation ($P < 0.05$, $P < 0.01$). After treatment, basic treatment 1 and massage treatment 1 reversed GV as demonstrated by radiography of the UGT using iodine-containing contrast. In contrast to basic treatment 1, massage treatment 1 showed remarkable improvement ($P < 0.05$, $P < 0.01$). After treatment, basic treatment 2 and massage treatment 2 reversed GER as shown by 24-h pH monitoring of the distal esophagus. In contrast to basic treatment 2, massage treatment 2 showed remarkable improvement ($P < 0.05$, $P < 0.01$) (Table 5, 6).

Severe pneumonia
Before treatment, there was no significant difference among all groups with regard to severe pneumonia ($P > 0.05$). After treatment, compared with basic treatment groups, massage treatment groups showed a lower prevalence of severe pneumonia ($P < 0.05$) (Table 1, 7).

Safety
Local redness or mild lesions appeared after massage because of tender skin. To avoid skin injury, baby oil was used before massage (talcum powder was not used because it its fine particles can stimulate coughing). No other problems regarding safety were observed.

Case report
A 2-month-old female was admitted to our hospital because of coughing and dyspnea of 20-day duration that was refractory to anti-infection therapy for 14 days at a local hospital. Coughing and dyspnea were accompanied with vomiting. She had choked on milk on seven occasions during the entire course of her illness. After hospital admission, she had undergone relevant examinations and was diagnosed with infant pneumonia.

Notes: BTG2: basic treatment group 2 (omeprazole: 0.5-0.8 mg/kg, qd, 30 min before breakfast, continued for 2 weeks; domperidone: 0.2-0.3 mg/kg, tid, 30 min before a meal, continued for 2 weeks). MTG2: massage treatment group 2 (domperidone: 0.2-0.3 mg/kg, tid, 30 min before a meal, continued for 2 weeks; massage: (15 ± 2) min each time, qd, continued for 1 week).
Mechanism of massage on infant pneumonia complicated by GV and GER

GV comprises pathologic rotation of the stomach with GER (Figure 1B-1C), and congenital heart disease. Twenty-four-hour pH monitoring of the distal esophagus confirmed GER. Microbiologic culture of sputum showed growth of normal bacterial colonies in the upper respiratory tract. After 8 days of basic treatment and massage treatment, chest radiography showed absorption of inflammatory foci, and radiography of the UGT using iodine-containing contrast demonstrated correction of stomach rotation (Figure 1D-1F). She was discharged from hospital and did not show recurrence over a 1-week follow-up period.

**DISCUSSION**

Correlation and clinical characteristics between GV with GER-induced pneumonia in infants

Infant pneumonia is closely related to GV with GER. Owing to anatomic defects, 50% of neonates and infants suffer from GER. In a survey of 5610 outpatients, Liu et al. reported that 3560 cases were diagnosed with GER (62.50%).

Infant pneumonia complicated by GER can be severe and recur. Our previous retrospective study of 148 patients showed that 82.22% of cases had severe symptoms and 62.16% were diagnosed with type-II respiratory failure. For infants with pneumonia, GV and GER, antibiotics can act only against chest infections; they have no effects on GV or GER. Postural therapy, by promoting gastric emptying to reduce GER instead of changing the anatomic structure of the gastroesophageal junction, can only attenuate, and not cure, GV in a short time. Postural therapy has been recommended as third-line therapy since 1998. In our study, postural therapy was carried out by specially trained nurses to avoid/attenuate vomiting-and choking on milk-induced asphyxia. In children, GER is frequently associated with GV. GER can enhance infant pneumonia, which is associated with the recurrence of chest infections, and infant pneumonia also aggravates GER, thereby forming a vicious circle. We found that 12 discharged patients in basic treatment groups (14.45%) suffered recurrence within 1 week.

Study and clinical approach of infant pneumonia, GV and GER

There have been few studies into infant pneumonia complicated by GV and GER. Li et al. stated that clinicians must take note of unresolved infant pneumonia or the failure of antibiotic treatment and GV, and that successful conservative treatment should include postural therapy to attenuate GV-induced vomiting of milk. Wang et al. reported that GER is the major cause of recurrent chest infections in the pediatric population. They also claimed that a definitive diagnosis and timely treatment of GER is crucial for patients with a history of repeat or lasting respiratory symptoms. Su et al. described the case report of a 13-month-old boy with GV-induced GER in association with repeated coughing and dyspnea lasting 1 year. He showed good improvement after surgery (fundoplication). Federica et al. stated that GV should be suspected in children with a history of recurrent respiratory infections. Guidelines for Diagnostic and Clinical Approaches of Pediatric GER (Trial Guidelines) reported that pathologic GER is part of gastroesophageal reflux disease. Those guidelines stated that appropriate therapy is necessary, ranging from general treatment (postural, diet), drug therapy (inhibitors, histamine receptor blockers, prokinetics, mucosal protectors) to surgery or upper gastrointestinal endoscopy. Therefore, effective treatment for infant pneumonia complicated by GER is reliant not only on standard anti-inflammatory treatments but is also highly related to reduction of GER.

**Table 7** Severe pneumonia after procedures in patients (*n* (%) )

<table>
<thead>
<tr>
<th>Severe pneumonia</th>
<th>MTG1 (<em>n = 60</em>)</th>
<th>MTG2 (<em>n = 30</em>)</th>
<th>MTG (<em>n = 90</em>)</th>
<th>BTG1 (<em>n = 60</em>)</th>
<th>BTG2 (<em>n = 30</em>)</th>
<th>BTG (<em>n = 90</em>)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type- I respiratory failure</td>
<td>3 (15.00)</td>
<td>2 (18.18)</td>
<td>5 (16.13)</td>
<td>5 (27.73)</td>
<td>3 (25.00)</td>
<td>8 (23.53)</td>
</tr>
<tr>
<td>Type- II respiratory failure</td>
<td>2 (10.00)</td>
<td>1 (5.26)</td>
<td>3 (9.68)</td>
<td>7 (31.82)</td>
<td>4 (33.34)</td>
<td>11 (32.35)</td>
</tr>
<tr>
<td>Others</td>
<td>2 (10.00)</td>
<td>0 (0.00)</td>
<td>2 (6.45)</td>
<td>2 (9.10)</td>
<td>1 (8.33)</td>
<td>3 (8.82)</td>
</tr>
<tr>
<td>Total severe cases</td>
<td>7 (35.00)</td>
<td>4 (36.36)</td>
<td>11 (35.48)</td>
<td>14 (63.64)</td>
<td>8 (66.67)</td>
<td>22 (64.71)</td>
</tr>
</tbody>
</table>

Notes: BTG1: basic treatment group 1 (omeprazole: 0.5-0.8 mg/kg, qd, 30 min before breakfast, continued for 2 weeks; domperidone: 0.2-0.3 mg/kg, tid, 30 min before a meal, continued for 2 weeks); BTG2: basic treatment group 2 (omeprazole: 0.5-0.8 mg/kg, qd, 30 min before breakfast, continued for 2 weeks; domperidone: 0.2-0.3 mg/kg, tid, 30 min before a meal, continued for 2 weeks); BTG: Basic treatment groups 1 and 2; MTG1: massage treatment group 1 (domperidone: 0.2-0.3 mg/kg, tid, 30 min before a meal, continued for 2 weeks; massage: (15 ± 2) min each time, qd, continued for 1 week); MTG2: massage treatment group 2 (domperidone: 0.2-0.3 mg/kg, tid, 30 min before a meal, continued for 2 weeks; massage: (15 ± 2) min each time, qd, continued for 1 week); MTG: massage treatment groups 1 and 2.

9 exclusion cases which were transferred to ICU for severe pneumonia are exclude in Tables 5 and 6 while those are include in Table 7. *P < 0.05 vs BTG.
around its axis, which causes total or partial obstruction of the gastrointestinal tract. Gastric rotation can occur on its longitudinal (organoaxial) or transverse (mesenteroaxial) axis. Stomach rotation about its longitudinal or transverse axes is defined as “combined volvulus”. In our study, 180 instances of GV were classified into 152 organoaxial (84.44%), 26 mesenteroaxial (14.44%) and 2 combined volvulus (1.11%). GV in infants aged < 6 months may be functional and not require treatment. Severe coughing generated by pneumonia-induced choking on milk can aggravate respiratory obstruction and asphyxia. Therefore, targeted therapy for GV complicated by pneumonia is necessary. In Traditional Chinese Medicine, infant pneumonia, GV and GER are referred to as vomit, cough, and dyspnea and cough due to lung heat disease, respectively. Oral decoctions are not effective owing to the concurrent symptoms of coughing and vomiting. Non-oral massage involves: rectilinear pushing manipulations from the palmar crease to Banmen (EX-UE) to attenuate vomiting; finger-pushing massage of abdominal Yin and Yang (EX-CA) and poking of Tianshu (ST 25) to promote digestion, strengthen enterokinesia, and improve flatus; palpation of the abdomen and poking Zusanli (ST 36) to strengthen the body, promote growth and remove etiologic factors because absence/laxity of the anchoring ligaments of the stomach are predisposing factors to chronic GV. The common effects are to strengthen the spleen and stop vomiting, strengthen the body, and remove stagnation. Once-daily massage for 7 days will gradually correct and improve stomach rotation and subsequent reflux. Compared with other treatments, massage takes a short time, is safe, and is acceptable to many parents.

Improvement of the prognosis by timely correction of stomach rotation for infant pneumonia complicated by GV and GER
Pneumonia is one of the major reasons of death in those aged < 5 years in developing countries.
nia-induced choking on milk can generate coughing, and vomiting of milk generated by GV with GER can aggravate coughing. Hence, a vicious circle is formed that is a risk factor of asphyxia in infants. In our study, among 180 hospitalized patients, 67 children had choking on milk-induced asphyxia and 3 children underwent cardiopulmonary resuscitation for choking on milk-induced cardiac arrest and apnea. Liu et al. \(^{10}\) reported a prevalence of milk-choking in infant GER of 11.18% that led to a high risk of severe complications such as milk aspiration, apnea, and sudden death. Our results showed that the prevalence of severe pneumonia in basic treatment groups was remarkably higher than that in massage treatment groups. We found that timely correction of stomach rotation by massage attenuated GER to elicit a reduction of the prevalence of severe complications for infant pneumonia with GER. Our research illustrated that massage can prevent GV with GER-induced infant pneumonia by timely correction of stomach rotation and subsequent attenuation of GER. Massage as an intervention in Traditional Chinese Medicine may be an important method for infants with GER-induced pneumonia.

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**REFERENCES**